Hitachi Zosen INOVA

# Thun / Switzerland

## Energy-from-Waste Plant

18.4 t/h, 46 MW

# KVA Thun – an urban facility meets the highest economic, ecological and architectural standards.

The KVA Thun energy-from-waste plant processes 100,000 tons of combustible waste every year, serving a total of 300,000 residents in 150 communities. The city, located on Lake Thun, is the economic hub of the Bernese Mittelland and Oberland, known for its snow-clad mountains and picturesque landscapes. The plant produces about a third of the electricity consumed in the city of Thun, and also provides district heating for adjacent public-sector facilities.

**Minimal emissions during processing and delivery.**
Because of the plant's close proximity to the city of Thun, particular attention was paid to sophisticated ecological and safety engineering concepts. It was important not only to provide reliable waste treatment, but also to minimise noise and odor pollution resulting from both delivery activities and actual operation.

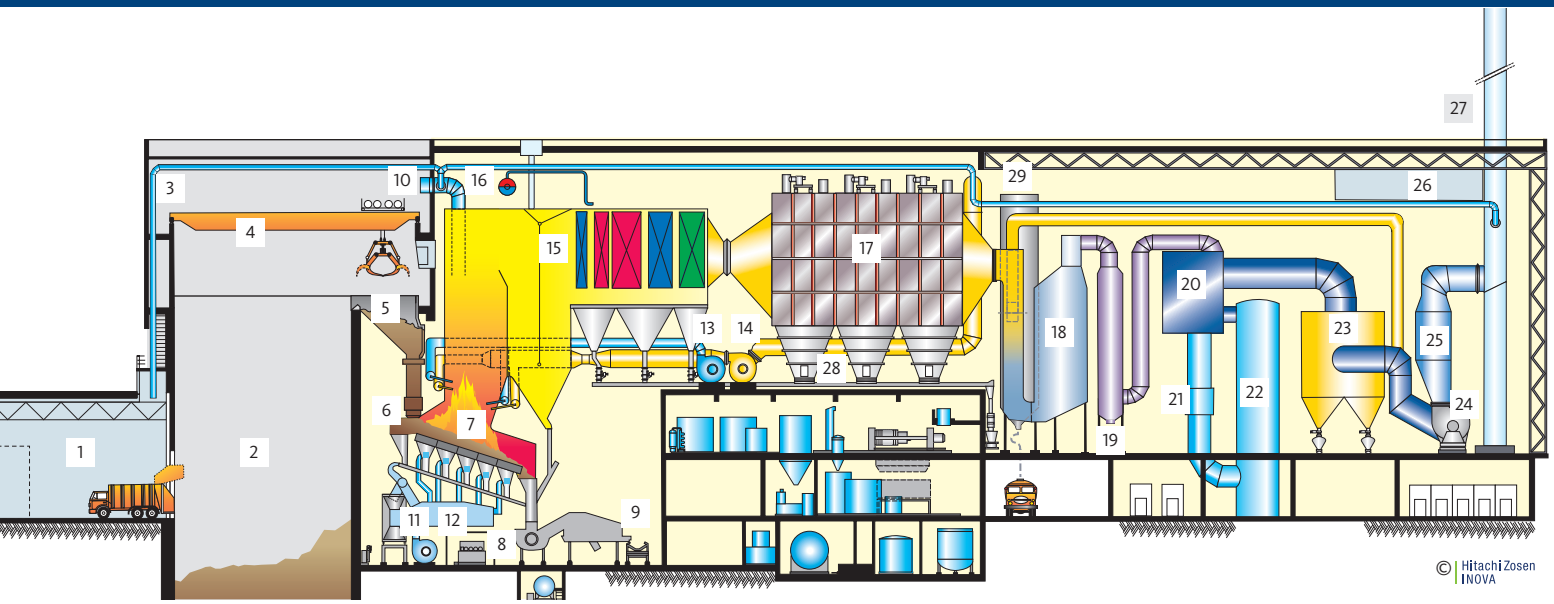
**Emission control starts with transportation.**
An efficient traffic concept ensures that waste travels only short distances by truck. About 40 percent is brought by rail to the plant, where it is unloaded in an enclosed hall. To prevent odor emissions, air for the combustion system is drawn in from the waste pit and the unloading area. This creates a slight, negative pressure that prevents odors from escaping.

**Optimum combustion with energy recovery.**
A crane mounted clamshell delivers the waste into the feed hopper. Sewage sludge is mixed into the waste within the feed hopper before it reaches the incineration section via a ram feeder. An Hitachi Zosen Inova grate, encompassing five individually controllable zones for the various incineration phases (drying, ignition, combustion, and burnout), optimises waste combustion. For maximum flexibility in terms of waste material calorific values, the first two main combustion zones were equipped with a Hitachi Zosen Inova water-cooled Aquaroll® grate. Waste heat from this section is used, via a closed-loop cooling system and a heat exchanger, to preheat the primary air. Secondary air and recirculated flue gas are tangentially injected at high velocity into the secondary combustion chamber above the grate, resulting in intensive mixing and thorough burnout of combustion gases. The energy released during combustion is transferred to the water/steam circulation loop in the downstream four-pass boiler.

**Efficient flue gas cleaning.**
Reliable removal of contaminants and low emissions are essential. The plant's efficient air pollution control system ensures not only that these requirements are met, but that the results are in fact much better than Swiss Air Quality Ordinance (LRV) standards. The flue gas treatment consists of the following sections: electrostatic precipitator, SCR (selective catalytic reduction) DeNOx system, residual heat recovery, wet scrubber, and bag filters.

Most of the particulates and the heavy metals bound to them are removed from the flue gas in the electrostatic precipitator. In the SCR unit that follows, the catalyzer breaks down nitrogen oxides into nitrogen and water, both natural constituents of air. The flue gases, now at a temperature of about 260°C, are cooled to ca. 170°C by an economiser, and the acid gases such as sulfur dioxide and hydrogen chloride are then washed out in the wet scrubber. After reheating in the gas/gas heat exchanger, fine particulates, dioxins, and any remaining heavy metals are removed in the fabric filter. An induced draft fan blows the clean flue gas into the 70-meter high stack. Before it leaves the plant, a continuous measurement system checks conformity with stringent emissions requirements.

**Fly ash treatment.**
In the fly ash washing section (FLUWA), wash water from the wet scrubber is processed together with the fly ash. After a pre-filtration operation, mercury is first removed in a selective ion exchanger. The wash water is then transferred into the FLUWA, where other heavy metals are extracted. The fly ash, now free of heavy metals, is then separated from the wash water on a vacuum belt filter, and salts are removed from the filter cake by intensive rinsing.




| Waste receiving and storage | Combustion and boiler | Flue gas treatment | Residue handling and treatment |
|---|---|---|---|
| 1 Tipping hall | 5 Feed hopper | 17 Electrostatic precipitator | 28 Ash conveying system |
| 2 Waste pit | 6 Ram feeder | 18 SCR DeNOx and catalyzer | 29 Residue silo |
| 3 Waste pit ventilation | 7 Hitachi Zosen Inova grate | 19 Economiser | |
| 4 Waste crane | 8 Ram bottom ash extractor | 20 Gas/gas heat exchanger | |
| | 9 Bottom ash handling | 21 Quench | |
| | 10 Primary air intake | 22 Wet scrubber | |
| | 11 Primary air fan | 23 Fabric filter | |
| | 12 Primary air distribution | 24 Induced draft fan | |
| | 13 Secondary air fan | 25 Silencer | |
| | 14 Flue gas recirculation fan | 26 Emissions measurement | |
| | 15 Four-pass boiler | 27 Stack | |
| | 16 Boiler drum | | |

The scrubbed and dewatered fly ash is mixed in with the bottom ash and disposed of along with it.

### Maximum reuse of residues.

The dissolved heavy metals are precipitated out, dewatered in a filter press, and dried. The filter cake, consisting mostly of zinc hydroxide, is sent out for recycling. Ferrous metal scrap in the waste is also reused: the bottom ash is passed over a magnetic separator where ferrous metals are separated from the remaining bottom ash and then forwarded to a recycling company. Non ferrous metals are separated from bottom ash off-site as well.

### Energy for the region.

Energy recovered from combustion in the form of steam is converted into electrical power and district heat. This conversion takes place in a turbine generator set consisting of an extraction/condensation turbine with regulated low-pressure extraction and ports for district heat output.

The KVA Thun plant is designed to produce a maximum of 12 MW of electricity and 25 MW of district heat. On average, it covers about a third of the city of Thun's electric power requirement.

### Function defines architecture.

High standards were applied not only to the plant's technology, but to its architecture as well. The design was created by Swiss architects who received their inspiration from the plants sophisticated technology and its modern functionality. The result is a building complex with an air of calm control. Instead of an ornamental exterior, it presents forms and contrasts forged by what happens inside. The eye-catcher is the all-glass south facade, which gives passersby a glimpse of the technology and exploits it as a design element. KVA Thun, located in the hub of tourism of the Bern region, is a facility that meets the highest standards of ecology, economy, and esthetics.

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# Thun / Switzerland Energy-from-Waste Plant

## General project data

| | |
|---|---|
| Owner and operator | AG für Abfallverwertung, AVAG |
| Start of operation | 2004 |
| Total investment | CHF 150 million |
| Scope of Hitachi Zosen Inova AG | Combustion system, boiler, energy recovery, flue gas treatment, fly ash scrubber, wastewater treatment, electrical and control systems |
| General contractor | Hitachi Zosen Inova AG (without civil works) |
| Plant design | Hitachi Zosen Inova AG |

## Technical data

| | |
|---|---|
| Annual capacity | 100,000 t (= 13.1 t/h) |
| Number of trains | 1 |
| Throughput per train | 13 t/h (nom) – 18.4 t/h (max) domestic and commercial waste |
| Calorific value of waste | 12.6 MJ/kg (min) – 16L.5 MJ/kg (max) |
| Thermal capacity | 46 MW |
| Sewage sludge co-combustion | Dewatered (20–40% dry matter), up to 10% of waste throughput |

## Bulky waste shredding

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|---|---|
| Type | Rotary shears |

## Combustion system

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|---|---|
| Grate type | Hitachi Zosen Inova grate |
| Grate size | Length: 10.2 m, width: 6.0 m |
| Grate cooling | First two zones water-cooled (Aquaroll®) |

## Boiler

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|---|---|
| Type | Four-pass boiler, horizontal |
| Steam quantity per train | 54.4 t/h |
| Steam pressure | 40 bar |
| Steam temperature | 400°C |

## Flue gas treatment

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|---|---|
| Concept | Electrostatic filter, SCR DeNOx, residual heat extraction, wet scrubber, reheater, bag filter for dioxin removal |
| Flue gas volume per train | 82,000 $m^3$/h |
| Flue gas temperatures | 130°C (stack) |

## Energy recovery

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|---|---|
| Type | Extraction-condensation turbine |
| Electric power | 12 MW (max.) |
| District heating output | 25 MW (max.) |

## Residues

| | |
|---|---|
| Bottom ash | 20,000 t/a |

## Special features

| | |
|---|---|
| Fly ash treatment | Acid fly ash washing (FLUWA) with zinc recovery |
| Ferrous metals | Onsite recovery of approx. 3,500 t/a |
| Metal recycling | Zinc concentrate of approx. 720 t/a |